**Experiment 7:**

Capacitors

**Ben Giftakis**

TA: Mario Rojas

Physics 181

8/17/20

**Purpose**: The purpose of this lab is to experiment with capacitors and their charge in relation to current and voltage over time.

**Data**:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | Part 1 |  |  |
| C1,dm (µF) | | Cs,dm (µF) | Cs,th (µF) | %diff |
| 0.1037 |  | 0.0505 | 0.0505 | 0 |
| C2,dm (µF) | | Cp,dm (µF) | Cp,th (µF) | %diff |
| 0.0985 |  | 0.201 | 0.2022 | 0.593 |
|  |  |  |  |  |
| R1 (kΩ) |  |  |  |  |
| 34.96 |  |  |  |  |
| V0 (V) |  |  |  |  |
| 8.0 |  |  |  |  |

Table : initial circuit calculated and measured values

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Part 2 |  |  |  | **N** |  |  |  |  |
| Vc (V) | V0/Vc | ln(V0/Vc) | t (ms) | **8** |  | Cdm (µF) | C1,exp (µF) | %diff |
| 8.0 | 1 | 0 | 0.00 | **slope** |  | 0.1037 | 0.109728 | 5.493 |
| 7.0 | 1.1429 | 0.13353 | 0.60 | **(units)** |  |  | SC1,exp |  |
| 6.0 | 1.3333 | 0.28768 | 1.15 | **3.836074** |  |  | 0.001612 |  |
| 5.0 | 1.6 | 0.47 | 1.75 | **intercept** |  |  |  |  |
| 4.0 | 2 | 0.69315 | 2.58 | **(units)** |  |  |  |  |
| 3.0 | 2.6667 | 0.98083 | 3.62 | **-0.01689** |  |  |  |  |
| 2.0 | 4 | 1.38629 | 5.20 | **R2** |  |  |  |  |
| 1.0 | 8 | 2.07944 | 8.10 | **0.998706733** |  |  |  |  |
|  |  |  |  | **Sy** |  |  |  |  |
|  |  |  |  | **(units)** |  |  |  |  |
|  |  |  |  | **0.104878** |  |  |  |  |
|  |  |  |  | **Sslope** |  |  |  |  |
|  |  |  |  | **(units)** |  |  |  |  |
|  |  |  |  | **0.056356** |  |  |  |  |
|  |  |  |  | **Sintercept** |  |  |  |  |
|  |  |  |  | **(units)** |  |  |  |  |

Table : 2d stats with time draining capacitor

|  |  |  |
| --- | --- | --- |
| Part 3 |  |  |
| t1/2C,exp (ms) | t1/2C1,th (ms) | %diff |
| 2.58 | 2.65896412 | 2.97 |
| t1/2Cs,exp (ms) | t1/2Cs,th (ms) | %diff |
| 1.25 | 1.22373748 | 2.146 |
| t1/2Cp,exp (ms) | t1/2Cp,th (ms) | %diff |
| 4.9 | 4.89979642 | 0.004 |

Table : half life data

**Calculations**:

𝑉0=Vr+Vc

)

)

Cp = C1 +C2

**Discussion**:

Part 1

The capacitance in series was measured to be .0505 microfarads, when calculated it came out to be the same with a %diff of 0%, this data is perfect. Measured using the series capacitance formula the only sources of error would be from the precision of instruments rather than any experimental flaws. The capacitance of the capacitors in parallel was measured to be .201 microfarads and calculated to be .2022 microfarads. With a %diff of merely .593% this is also seeming quite reliable. You could reduce the error by accounting for resistance of the equipment and wire however these are negligible

Part 2

The capacitance of C1 was calculated to be .11+-.002 microfarads. Compared to the direct measurement of .1037 microfarads there’s a 5.49% difference. This is slightly higher than negligible. It also fails the precision accuracy test. I suspect there may be some slight calibration issues or perhaps the resistance of the equipment is something that should not be ignored.

Part 3

The half life of C1 was calculated to be 2.65896412 ms, compared to the experimental value of 2.58, ms there is only 2.97% difference. The half life of the capacitors in the circuit in series is 1.22373748 ms, the experimental value was 1.25 ms which is a 2.146% difference. Finally, the half life of the capacitance of the series in parallel was calculated to be 4.89979642 ms, with the experimental value being 4.9 ms, which is .004% different. All of the calculations are quite accurate, and only varied slightly from the experimental data, this is likely to be due to instrument imprecision, or propagated error from previous parts.

**Conclusion & results**:

Cs,th = 0.0505µF, 0% diff

Cp,th = 0.2022 µF, 0.593% diff

C1,exp = 0.109727527 +- 0.001612 µF, 5.493% diff

½Tc1,th = 2.65896412 ms, 2.97% diff

½Tcs,th = 1.22373748 ms, 2.146% diff

½Tcp,th = 4.89979642 ms, .004% diff

All of the data appears to have been mostly in line, the only likely source for error that isn’t negligible is the resistance of the equipment used, such as batteries, function generator etc.

**Questions**:

1.

V

This lines up with 3V, with a t value of 3.62 ms

2. With a low %diff this resistance and be ignored

3.

4. with this calculation the parallel circuit has greater capacitance.